Photoalignment of DNA: Harnessing Liquid Crystalline Order Without Modification

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Photoalignment and patterning of structured materials have long relied on synthetic liquid crystal systems with designed photoreactive groups. DNA, by contrast, has been largely overlooked as a photoalignment platform despite its intrinsic liquid crystalline behavior. We show that DNA can be photoaligned without any sequence modification or functional group engineering, by exploiting its high negative charge density, which enables strong electrostatic coupling with a cationic photopolymerizable monomer. Under scanning UV irradiation, polymerization-induced mass transport aligns DNA chains along the scanning direction, yielding uniaxially ordered hydrogels with anisotropic mechanical properties. When particle-array substrates are introduced, molecular alignment and periodic patterning are simultaneously achieved. These results reframe DNA as a scalable, sequence-free, and biocompatible platform for photopatterning, opening new directions for anisotropic biopolymer-based soft materials.

Biography:

Dong Ki Yoon is a professor in the Department of Chemistry at the Korea Advanced Institute of Science and Technology (KAIST), South Korea. He received his B.S. in Chemical Engineering from Yonsei University (2001), and his M.S. and Ph.D. in Chemical and Biomolecular Engineering from KAIST (2007). Following his doctorate, he worked as a Senior Engineer at Samsung Electronics before joining the University of Colorado, Boulder as a Research Associate in liquid crystal materials. He joined KAIST in 2011, where his group focuses on the alignment and self-assembly of liquid crystalline polymers and biopolymers, as well as the fabrication of functional composite materials. He serves as Associate Editor of the journal '*Liquid Crystals*'.